

(19) Japan Patent Office (JP)
(11) Public Patent Disclosure Bulletin

(12) Public Patent Disclosure Bulletin No. (A): 61-270060
(43) Public Patent Disclosure Bulletin Date: November 29, 1986
Request for Examination: Not yet made
Number of Inventions: 1
Total Pages: 3

(51) Int. Cl. 4	Identification Code	Internal File Nos.
B 24 B 7/22		7512-3C

(54) Title of Invention: Wafer Polishing Method
(21) Patent Application No.: 60-112275
(22) Patent Application Date: May 2, 1985
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SPECIFICATION

1. Title of the Invention
Wafer Polishing Method

2. Claims

(1) A wafer polishing method characterized by mirror-finish polishing of a wafer, wherein there is mirror-finish polishing of a wafer by means of a wafer and a polishing plate established on a window through which light passes, arranged in a way in which they are introduced to a chemical solution facing each other, coincident to light that passes through said window irradiating the polishing plate and the wafer, and relative motion generated between the polishing plate and the wafer.

[Cont'd from P.1]

3. Detailed Explanation of Invention

[Industrial Field of Application]

This invention concerns a polishing method that mirror-finish polishes a wafer.

[Conventional Technology and Its Problems]

In the conventional method used in mirror-finish polishing a wafer, the method of processing the wafer uses a polishing liquid in which a wafer of silicon dioxide, for example, is suspended in an alkaline chemical solution and forces a macromolecular material such as polyurethane as the main component, into the polishing plate by means of relative motion of the polishing plate and the wafer. In order to accelerate the processing speed in the conventional method, the force pressing on the polishing plate must be extreme. However, because the polishing plate is composed of a viscoelastic body of polyurethane, etc. and an extreme amount of force is applied to the edge surface, the result on the edge surface is compromised due to deterioration of the surface plane.

Though there is also a chemical polishing method whereby a wafer is polished while immersed in the chemical solution, because of the tendency of the chemical solution to crystallize at etching speed, it has the substantial disadvantage of producing surface roughness.

[Objective of Invention]

The objective of this invention is to eliminate these disadvantages and to acquire a polishing method capable of mirror-finishing the surface of a wafer perfectly with processing efficiency.

[Composition of Invention]

This invention is a wafer polishing method characterized by mirror-finish polishing of a wafer, wherein there is mirror-finish polishing of a wafer by means of a wafer and a polishing plate established on a window through which light passes, arranged in a way in which they are introduced to a chemical solution facing each other, coincident to light that passes through said window irradiating the polishing plate and the wafer, and relative motion generated between the polishing plate and the wafer.

61-270060 (2)

This invention is based upon the idea that it is possible to produce a mechanically smooth, mirror-finished wafer surface by means of irradiation of light on the wafer and in the chemical solution, where the reaction speed of the wafer and chemical solution accelerates due to optical or thermal excitation of the wafer surface and/or the chemical solution, and to the introduction of the chemical solution to and generating relative motion between the polishing plate and the wafer.

To be more precise in reference to the excitation of the wafer surface, when light wave length λ has less than 1.08 eV of silicon band gap energy, for example, it is difficult to thermally heat a low concentrate Si plate but absorption by means of an

[Cont'd from P.2]

independent carrier on a high concentration Si plate is a way of substantially inducing thermal excitation, thus enabling an activity state.

Likewise, when light wave length λ_2 possesses more than 1.08 eV of silicon band gap energy, not only is the Si plate thermally heated, but because it is possible to excite and activate solid-state internal electronics, an activity state of excitation is created without being restricted by a high or low concentration Si plate.

Furthermore, when light wave length λ_3 possesses more than 3.4 eV of Si Γ band transition energy, the pattern of the solid-state internal electronics of a Si plate is repeated, and an absorption coefficient (α) of light wave length λ_3 (ultraviolet light) of Si greater than that on an order of $10^5/\text{cm}$ enables an excitation activity state only in the immediate vicinity of the surfaces of the electronics.

As in the above, by optically or thermally exciting a wafer surface by means of light energy that irradiates a wafer, acceleration of the reaction speed of the polishing process becomes possible.

[Working Example]

Explanation of the working example of the polishing method of this invention is based upon the diagram.

Figure 1 is a diagram used to explain the first working example of this invention and illustrates a case in which a single crystal silicon plate is used as a wafer. A polishing plate 5 that possesses windows 4 through which light partially passes is established between a wafer 2 fastened to a rotation-capable support plate 1 and a mercury lamp light source 3. On this polishing plate large numbers of apertures 3mm in diameter used as windows 4 are established 2mm apart on non-woven polyurethane material that is glued to a quartz glass plate. The polishing plate 5 is supported by a rotation-capable support column 7 inside the tank 6 which is made of a transparent material, and the polishing plate 5 and the process surface of the wafer 2 are inserted inside the tank so as to be immersed in a 1 molar solution of fluorinated sodium.

The wafer 2 is pressed against the polishing plate 5 with a pressure of $10\text{g}/\text{cm}^2$ and, while the UV light 9 from the light source 3 irradiates the process surface of wafer 2, passing through windows 4 of the polishing plate 5, by means of rotation of the polishing plate 5 and the wafer in the direction indicated in the diagram, the wafer 2 and the polishing plate 5 are set in relative motion and the wafer 2 is polished. By means of the irradiation of the UV light 9 the wafer 2 and the chemical solution 8 attain an activated state of excitation and because a reaction is easily achieved reaction speed increases, then, in order to abrade the surface of the wafer 2 with the polishing plate 5, the mechanical process is performed with the surface immersed which enables an increase in the processing speed while mirror-finishing the wafer.

When compared to a case in which a light source is not used, this working example was able to increase the processing speed 5-fold and both a surface cleaning and an excellent mirror finish were obtained.

In the working example above, the wafer is pressed against the polishing plate, polished, and a chemical solution utilized for its lubricating effect, however, it is best to use a method that lubricates the wafer surface that is not glued to the polishing plate.

[Cont'd from P.2]

Again, in the working example above and relative to the Si wafer, it is possible to use the method of this invention with other semiconductor single crystal substrates as well, such as GA, As, and InP.

Furthermore, as shown by the working example above, this invention is one that is not restricted but an appropriate selection and acquisition of type of light source, polishing plate materials, etc., is necessary.

[Results of Invention]

In the conventional method, in order to polish a wafer being held with high pressure, a polishing liquid is introduced to the viscoelastic polishing plate made of a macromolecular material such as polyurethane, etc. and, even though all wafers may receive a mirror finish, the large surface planes deteriorate. With this invention's

61-270060 (3)

method, the wafer surface and/or the chemical solution is excited and activated not by a large amount of pressure but by light energy, processing speed accelerates due to an increase in reaction speed, and because it is possible to produce a mirror finish on a surface by abrading a wafer surface, it is possible to accurately and efficiently acquire a wafer with a superior surface plane.

4. Brief Explanation of Illustration

6 Tank
8 Chemical Solution
4 Window
5 Polishing Plate
1 Support Substrate
2 Wafer
9 Light
3 Light Source

Figure 1

Figure No. 1 is an illustration that shows the condition of polishing by means of the polishing method of this invention.

- 1 Support Substrate
- 2 Wafer
- 3 Light Source
- 4 Window
- 5 Polishing Plate
- 6 Tank
- 7 Support Column
- 8 Chemical Solution
- 9 Light

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-359-

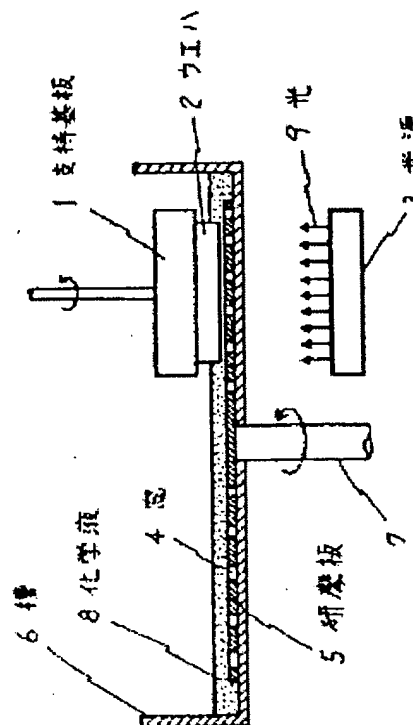
POLISHING METHOD FOR WAFER

Patent number: JP61270060
Publication date: 1986-11-29
Inventor: HAMAGUCHI TSUNEO; others: 01
Applicant: NEC CORP
Classification:
 - international: B24B7/22
 - european:
Application number: JP19850112275 19850527
Priority number(s):

Abstract of JP61270060

PURPOSE: To polish a wafer into mirror-finishing, by setting up the wafer and an abrasive plate provided with a window transmitting light so as to be opposed via a chemical solution, while making the wafer and the abrasive plate perform their relative motion via the chemical solution while irradiating the light to the chemical solution and the wafer through the said window.

CONSTITUTION: A wafer 2 is pressed to an abrasive plate 5 with a pressure of about 10g/cm^2 , and the wafer 2 and the abrasive plate 5 are rotated in an arrow direction via a chemical solution 8 kept in a tank 6 while irradiating ultraviolet rays 9 on a polishing surface of the wafer 2 through each window 4 of the abrasive plate. With this operation, the wafer 2 and the abrasive plate 5 start their relative motion, thus the wafer is polished. With irradiation of the ultraviolet rays 9, the wafer and/or the chemical solution 8 come into a state of being excited and activated, therefore they are easy to react so that a reaction velocity goes up and, what is more, a surface of the wafer 2 is subjected to friction, thus the surface is mechanically processed so smooth enough, making a removal rate increasable while polishing the wafer into mirror-finishing.



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⑩ 日本国特許庁(JP)

⑪ 特許出願公開

⑫ 公開特許公報(A)

昭61-270060

⑬ Int.Cl.⁴

識別記号

庁内整理番号

⑭ 公開 昭和61年(1986)11月29日

B 24 B 7/22

7512-3C

審査請求 未請求 発明の数 1 (全3頁)

⑮ 発明の名称 ウエハの研磨方法

⑯ 特 願 昭60-112275

⑰ 出 願 昭60(1985)5月27日

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明 細 書

1. 発明の名称

ウエハの研磨方法

2. 特許請求の範囲

(1) ウエハを鏡面研磨するにあたり、ウエハと、光を通す窓を設けた研磨板とを化学液を介して対向するように配置し、前記窓を通して化学液およびウエハに光を照射しながら、ウエハと研磨板とを化学液を介して相対運動させることにより、ウエハを鏡面研磨することを特徴とするウエハの研磨方法。

3. 発明の詳細な説明

〔産業上の利用分野〕

本発明はウエハを鏡面研磨する研磨方法に関するものである。

〔従来技術とその問題点〕

ウエハの鏡面研磨に従来用いられている方法には、ウエハを例えば二酸化シリコン SiO_2 をアルカリの化学液に懸濁した研磨液で、ポリウレタン等の高分子材料を主成分とする研磨板に押しつ

けて、研磨板とウエハとの相対運動により、ウエハを加工する方法がある。この従来の方法では加工速度を上げるためにはウエハの研磨板への押しつけ力を大きくしなければならない。しかし、研磨板はポリウレタン等の粘弾性体で構成されているため、ウエハの端面に大きな圧力が作用し、端面がだれる結果、平面度が悪化する欠点がある。

また、化学液中でウエハを研磨する化学研磨の方法があるが、化学液のエッチング速度の結晶方位による選択性のため、表面あらさが大きくなる欠点がある。

〔発明の目的〕

本発明の目的は、これらの欠点を除去せしめて、加工能率良くウエハ表面を鏡面にするのできる研磨方法を得ることにある。

〔発明の構成〕

本発明は、ウエハを鏡面研磨するにあたり、ウエハと、光を通す窓を設けた研磨板とを化学液を介して対向するように配置し、前記窓を通して化学液およびウエハに光を照射しながら、ウエハと

研磨板とを化学液を介して相対運動させることにより、ウェハを鏡面研磨することを特徴としている。

本発明はウェハおよび化学液に光を照射することにより、ウェハ表面およびまたは化学液を光学的または熱的に励起することによりウェハと化学液との反応速度を促進し、かつ化学液を介して研磨板とウェハとを相対運動させることにより、ウェハ表面を機械的に滑らかに鏡面にできるという考えに基づいてなしたものである。

ウェハ表面の励起についてさらに詳しく述べると、波長 λ_1 の光が例えばシリコンのバンド間エネルギー 1.08 eV より小さなエネルギーを有するときは低濃度Si基板は熱的に加熱されにくい、高濃度Si基板に対しては自由キャリアによる吸収が大きくなるので熱的に励起され、活性状態にすることができる。

また、波長 λ_2 の光が例えばSiのバンド間エネルギー 1.08 eV より大きなエネルギーを有するときは、Si基板は熱的に加熱されるだけでなく、固

体内電子を励起し活性化できるので、高濃度、低濃度Si基板に限らず、励起活性状態となる。

さらに波長 λ_3 の光がSiの Γ バンドの遷移エネルギー 3.4 eV より大きなエネルギーを有するときは、Si基板の固体内電子のみならず、波長 λ_3 の光(紫外光)のSiに対する吸収係数(α)が $10^5/\text{cm}$ オーダー以上になり極めて表面付近の電子だけを励起活性化することができる。

以上のように、ウェハを照射する光のエネルギーによりウェハ表面を光学的または熱的に励起させ、研磨加工の反応速度を促進させることが可能となる。

(実施例)

図面に基づき本発明の研磨方法の実施例について説明する。

第1図は本発明の一実施例を説明するための図であり、ウェハとして単結晶シリコン基板を用いた場合について述べる。

回転可能な支持基板1に接着したウェハ2と水銀ランプの光源3との間に、部分的に光を通す窓

4を有する研磨板5を設ける。この研磨板には、窓4として直径 3 mm の穴が 2 mm 間隔で多数設けられているポリウレタン不織布を石英ガラス板にはりつけたものを用いる。研磨板5は、透明な材料よりなる槽6内に回転可能な支柱7に支持されており、槽6内には化学液8としてフッ化ナトリウム1モル溶液を、ウェハ2の加工面と研磨板5とが浸るように入れる。

ウェハ2を圧力 10 g/cm^2 で研磨板5に押しつけ、研磨板の窓4を通してウェハ2の加工面に光源3から紫外光9を照射しながら槽6に保持された化学液8を介して、ウェハ2と研磨板5とを図示矢印の方向に回転することにより、ウェハ2と研磨板5とが相対運動をおこし、ウェハ2が研磨される。紫外光9を照射することにより、ウェハ2およびまたは化学液8が励起活性状態になり、反応しやすくなるため反応速度が上がり、さらに研磨板5によりウェハ2の表面を摩擦するため表面が滑らかに機械的に加工され、ウェハを鏡面にしながら加工速度を増加することができる。

本実施例によれば、光源を使用しない場合に比べて、加工速度を5倍に上げることができ、表面あらさも良好な鏡面が得られた。

以上の実施例では、ウェハを研磨板に押しつけて研磨したが、化学液の流体潤滑作用を利用して、研磨板に接触することなくウェハ表面を滑らかにする方法を用いてもよい。

また、以上の実施例では、シリコンウェハについて述べたが、他の半導体単結晶基盤例えばGaAs, InPについても本発明の方法を用いることができる。

さらに本発明は以上の実施例に限定されるものではなく、光源の種類、研磨板の材料等についても適宜選択し得ることは勿論である。

(発明の効果)

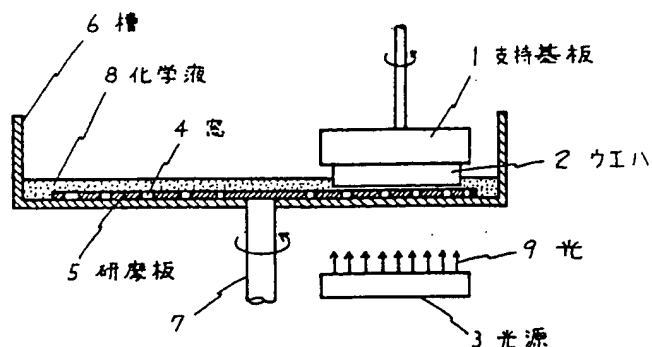
従来の方法では、例えばポリウレタン等の高分子材料からなる粘弾性体の研磨板に研磨液を介して、高圧で押しつけてウェハを研磨するために、ウェハ端面のだれも大きく平面度が悪化していたのに対し、本発明の方法によれば圧力を大きくす

ることなく光エネルギーによってウエハ表面およびまたは化学液を励起、活性化し、反応速度を増加させることにより加工速度を増し、かつウエハ表面を摩擦することにより表面を鏡面にしていくことができるので、平面度の優れたウエハを効率良く得ることができる。

4. 図面の簡単な説明

第1図は本発明の研摩方法による研摩状態を示す図である。

- 1 …… 支持基板
- 2 …… ウエハ
- 3 …… 光源
- 4 …… 窓
- 5 …… 研摩板
- 6 …… 槽
- 7 …… 支柱
- 8 …… 化学液
- 9 …… 光



第 1 図

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